REMARKS

This amendment is in response to the Final Office Action received in the above-referenced application. Applicant respectfully requests that the Examiner consider the proposed amendments to claims 1, 4, 9, and 12.

With respect to all amendments and cancelled claims, Applicant has not dedicated or abandoned any unclaimed subject matter. Applicant reserves the right to pursue prosecution of any presently excluded claim embodiments in future continuation and/or divisional applications.

Claim 1 has been amended to more clearly point out and distinctly claim the subject matter of the present invention. Specifically, claims 1 and 12 have been amended to recite that the first layer is formed of a metal oxide material "having the formula of M_xO_y" and to include the further limitation that the second layer is formed "on top of" the first layer. Support for this proposed amendment is found throughout the specification and figures, for example, in page 4, line 29 to page 5, line 3, and in Figure 3. Applicant respectfully submits that no new matter is added by this proposed amendment. Claims 4 and 9 are amended to correct changes in dependency given the amendments to the claims made herein.

Claim Rejections Under 35 U.S.C. §102(e)

The Examiner has rejected claims 1, 7, and 10-12 under 35 U.S.C. §102(e) as being anticipated by Yu et al. ("Yu"). Applicant disagrees and respectfully traverses the rejections.

A claim is anticipated under 35 U.S.C. §102 only if each and every element as set forth in the claim is found, either expressly or inherently described in a single prior art reference. Applicant respectfully submits that Yu does not teach each and every element recited in the proposed amended independent claims 1 and 12.

Specifically, Yu does not teach "a first layer formed of a metal oxide material having a dielectric constant κ and thickness t, the metal oxide material having the formula of M_xO_y" and "a second layer formed on top of said first layer, wherein said second layer is formed of a metal silicate material" as recited in proposed amended claims 1 and 12. Yu at best teaches in the exemplary embodiment illustrated in Figure 1, a structure 100 that may be formed of three layers, namely, layers 105, 102, and 103, that do not correspond to a metal silicate/metal oxide configuration as recited in the proposed claims.

"[A]a monocrystalline oxide transition layer 102 is optionally formed overlying substrate 101" (Yu, paragraph 0021). "Prior to forming layer 102 or any subsequent layer, a template layer 105 may be formed overlying substrate 101" (Yu, paragraph 0022). "In the embodiment of the invention illustrated in FIG. 1, a monocrystalline oxide-nitride insulating layer 103 is formed overlying transition layer 102" (Yu, paragraph 0023).

The exemplary embodiment of structure 100 illustrated in Figure 1 does not correspond to the multilayer dielectric film of proposed amended claims 1 and 12 of the present invention. Claims 1 and 12 specifically teach a metal oxide layer of the form M_xO_y (the first layer) being placed under a metal silicate layer (the second layer). The layers disclosed in Yu do not form a metal oxide layer of the form M_xO_y below a metal silicate layer and there is no suggestion or motivation in Yu for forming structure 100 in such a way.

In Yu, structure 100 is shown in Figure 1 with layer 102 sandwiched between layers 105 and 103. "In an exemplary embodiment, layer 102 may comprise an alkaline earth metal titanate, such as, for example, barium titanate ($BaTiO_3$), strontium titanate ($SrTiO_3$), or barium strontium titanate ($Sr_zBa_{1-z}TiO_3$, $0<z<1$), or another suitable oxide material, such as, for example, $LaAlO_3$ or $SrZrO_3$. In one embodiment, layer 102 is a layer of $SrTiO_3$ having a thickness of up to about 1 nm" (Yu, paragraph 0021). $SrTiO_3$ is an example of a metal oxide formed with two metals.

"Template layer 105 may include 1-10 monolayers of oxygen and an alkaline earth metal element suitable to successfully grow layer 102. Alternatively, template layer 105 may include 1-10 monolayers of oxygen, nitrogen, and an alkaline earth metal element suitable to successfully grow layer 102. For example, if layer 102 is formed of $SrTiO_3$, a suitable template layer may be Si-O-Sr or Sr-Si-O-N" (Yu, paragraph 0022). Si-O-Sr is an example of a metal silicate.

"In an exemplary embodiment, layer 103 is formed by epitaxially growing, by a process of molecular beam epitaxy, a layer of $M_nO_{m-x}N_x$ ($x<m$), wherein M is a metallic or semi-metallic element or combination of metallic and/or semi-metallic elements, such as, for example, strontium (Sr), titanium (Ti), barium (Ba), aluminum (Al), erbium (Er), calcium (Ca), magnesium (Mg), tantalum (Ta), bismuth (Bi), gadolinium (Gd), zirconium (Zr), hafnium (Hf), yttrium (Y), ruthenium (Ru), lanthanum (La), gallium (Ga), indium (In), lithium (Li), sodium (Na), potassium (K), rubidium (Rb), cesium (Cs), beryllium (Be), scandium (Sc), vanadium (V), niobium (Nb), chromium (Cr), molybdenum (Mo), tungsten (W), manganese (Mn), technetium (Tc), rhenium (Re), iron (Fe), cobalt (Co), rhodium (Rh), iridium (Ir), copper (Cu), silver (Ag), gold (Au), zinc (Zn), cadmium (Cd), mercury (Hg), thallium (TI), tin (Sn), lead (Pb), antimony (Sb), bismuth (Bi), cerium (Ce), praseodymium (Pr), neodymium (Nd), samarium (Sm), europium (Eu), terbium (Tb), dysprosium (Dy), holmium (Ho), thulium (Tm), protactinium (Pa), or uranium (U)" (Yu, paragraph 0024). Layer 103, however, is not a metal silicate. It is a metal oxide nitride of the composition $M_nO_{m-x}N_x$.

That is, Yu at best teaches a metal oxide layer (layer 102) sandwiched between a metal silicate layer (layer 105) and a metal oxide nitride layer (layer 103). The metal oxide layer is formed on top of the metal silicate layer and under the metal oxide nitride layer. Yu does not teach, disclose, or reasonably suggest a metal silicate layer formed on top of a metal oxide layer formed of a metal oxide material having the formula M_xO_y as disclosed in the present invention and recited in proposed amended claims 1 and 12.

Further, when Yu teaches removing the metal oxide layer (layer 102) sandwiched between the metal silicate layer (105) and the metal oxide nitride layer (layer 103), Yu is left with a structure that is formed of a metal silicate layer (layer 105) on top of a metal oxide nitride layer (layer 103), and not a metal silicate layer on top of a metal oxide layer formed of a metal oxide having the formula M_xO_y. Specifically, Yu teaches that "[I]if transition layer 102 is not present, insulating layer 103 may be formed overlying template layer 105" (Yu, paragraph 0023).

Yu, in fact, relies on having the metal oxide nitride layer as the top layer (rather than a metal silicate layer) for its insulating purposes and to reduce leakage currents in the device. "The concentration of nitrogen in layer 103 may be chosen such that the leakage current in the monocrystalline oxide film is minimized, or otherwise selected in accordance with the quality, performance, and/or manufacturing requirements of the device. In an exemplary embodiment, the concentration of nitrogen incorporated into insulating layer 103 may range from greater than 0 up to about 50 atomic percent of the total concentration of oxygen and nitrogen" (Yu, paragraph 0026).

That is, having nitrogen as part of the material forming the top layer is essential to the teaching of Yu. Yu does not therefore disclose or teach having a top layer formed of metal silicate on top of a metal oxide layer having no nitrogen in its composition.

Applicant therefore respectfully submits that Yu does not teach each and every element as set forth in Applicant's claims, either expressly or inherently. The rejections under 35 U.S.C. §102(e) should therefore be withdrawn.

Claim Rejections Under 35 U.S.C. §103(a)

The Examiner has rejected claims 1-5 and 7-12 under 35 U.S.C. §103(a) as being unpatentable over Bai in view of Yu. Applicant disagrees and respectfully traverses the rejections.

To establish a proper prima facie case of obviousness, three criteria must be met. First, there must be some suggestion or motivation, either in the cited references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify or combine the cited reference relied upon by the Examiner to arrive at the claimed invention. Second, there must be a reasonable expectation that the suggested modification or combination would be successful. Finally, the prior art reference (or references when combined) must teach or suggest each and every limitation of the rejected claims. The teaching or suggestion to make the claimed modification or combination and the reasonable expectation of success must both be found in the prior art, and not based upon in the applicant's disclosure. M.P.E.P. §706.02.

Applicant respectfully submits that the combined references do not teach or reasonably suggest Applicant's proposed amended claims. In particular, the combined references do not teach or suggest forming a metal oxide layer (first layer) under a metal silicate layer (second layer).

As stated above, Yu does not teach, disclose, or reasonably suggest forming structure 100 to have a metal silicate layer on top of a metal oxide layer formed of a metal oxide having the formula M_xO_y. Bai also does not teach, disclose, or reasonably suggest forming a multilayer dielectric with a metal silicate layer on top of a metal oxide layer formed of a metal oxide material having such formula.

The Examiner has suggested that Bai discloses a multilayer dielectric film comprising a first layer 120 formed of a metal oxide material, referring to paragraph 0019 of Bai, and a second layer 130 also formed of a metal oxide material, referring to paragraph 0018 of Bai. When Bai suggests the use of a third dielectric layer, Bai states that "[F]for a gate electrode 110 that is polysilicon, a third dielectric layer may be utilized to act as a barrier layer to prevent interaction between top dielectric layer 120 materials having high dielectric constants and the polysilicon gate material. Suitable third dielectric materials include, but are not limited to, HfO_2, ZrO_2,

BaO, La_2O_3, and Y_2O_3 (notably the same materials suitable as bottom dielectric layer 130)" (Bai, paragraph 0027).

While Bai suggests having a metal oxide layer sandwiched between two layers formed of the same materials, Bai only teaches, discloses, or suggests using metal oxide for those materials. Nowhere in Bai is there a suggestion or motivation to use a metal silicate layer surrounding a metal oxide layer. Similarly, nowhere in Yu is there a suggestion or motivation to use a metal silicate layer on top of a metal oxide layer. The metal silicate layer in Yu is under the metal oxide layer and the metal oxide nitride layer or under the metal oxide nitride layer, not on top of a metal oxide layer.

Furthermore, there is no suggestion or motivation in Yu to have top layer 103 be formed of a metal silicate on top of a layer (layer 102) formed of a metal oxide material having the formula M_xO_y. In particular, Yu stresses the importance of forming layer 103 as "[...]a high dielectric constant insulating layer on a semiconductor structure using a high dielectric constant oxide-nitride such as $M_nO_{m-x}N_x$ ($x<m$), wherein M is a metallic or semi-metallic element or combination of metallic and/or semi-metallic elements" (Yu, paragraph 0018). Yu's invention lies in the use of this metal-oxide-nitride layer as its top layer so that "[W]with nitrogen incorporated into the insulating oxide layer, the leakage current density can be significantly lower than in insulating oxide layers that do not incorporate nitrogen" (Yu, paragraph 0018).

That is, Yu specifically teaches away from forming a top layer with metal silicate as its top layer is formed of a metal-oxide-nitride. It would not be obvious to one of ordinary skill in the art to ignore Yu's teaching of using metal-oxide-nitride as the top layer and instead, use the a metal silicate layer on top of a metal oxide layer. There is no suggestion or motivation in Bai to use a metal silicate material for the top layer, and no suggestion or motivation in Yu for removing the metal-oxide-nitride material in favor of a metal silicate.

In short, the lack of means for providing a metal silicate layer on top of a metal oxide layer formed of a metal oxide material having the formula M_xO_y in any of the prior art references is a strong indication that those means were not obvious at the time the invention was made. Applicant therefore respectfully submits that the cited combination fails to render obvious the present invention.

Accordingly, Applicant respectfully submits that the application is in condition for allowance. If any matters can be resolved by telephone, the Examiner is invited to call the undersigned attorney at the telephone number listed below. Commissioner is authorized to charge any additional fees to Deposit Account No. 50-2319 (Order No. A-70028-2/MSS/MRC (463035-964)).

Respectfully submitted,

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